

THE CLAIMS

What is claimed is:

1. A method for manufacturing a multilayer semiconductor structure that includes an irregular layer, comprising:

providing a layer of irregular material on a donor substrate to form an irregular layer having a flat face at an interface with the donor substrate and having
5 an opposite, irregular face;

creating a weakened zone at a predetermined depth within the donor substrate;

providing an intermediate layer of material that covers the irregular face of the irregular layer, the intermediate layer providing a substantially flat surface;

10 bonding the substantially flat surface of the intermediate layer to a receiver substrate; and

detaching the donor substrate along the weakened zone to form the multilayer semiconductor structure that includes an useful layer, the irregular layer, the intermediate layer and the receiver substrate, wherein all of the irregular material of the irregular layer is present in the structure.

15

2. The method of claim 1 which further comprises treating the substantially flat surface of the intermediate material layer prior to bonding.

3. The method of claim 1 which further comprises implanting atomic species
20 into the donor substrate to a controlled mean implantation depth to form the weakened zone.

4. The method of claim 1 which further comprises heat treating to detach the donor wafer from the multilayer semiconductor structure.

25

5. The method of claim 1 wherein the intermediate layer is provided prior to creating the weakened zone in the donor substrate.

6. The method claim 1 wherein the weakened zone is created in the donor substrate prior to providing the intermediate material layer.
7. The method claim 1 wherein the weakened zone is created in the donor substrate prior to providing the layer of irregular material on the donor substrate.
8. The method of claim 7 which further comprises implanting atomic species into the donor substrate to a controlled mean implantation depth to form the weakened zone.
9. The method of claim 8 which further comprises detaching the donor substrate along the weakened zone by exposing the wafer to an appropriate heat budget.
10. The method of claim 7 which further comprises fabricating a detachable donor substrate having a weakened zone.
11. The method of claim 10 which further comprises creating the weakened zone by at least one of providing a porous region in the donor substrate, providing a reversible bonding interface between two wafers that comprise the donor substrate, or implanting atomic species into the donor substrate with a dosage that requires a predetermined amount of mechanical energy to detach the donor substrate along the weakened zone.
12. The method of claim 1 wherein the intermediate material layer is made of an amorphous material.
13. The method of claim 12 wherein the intermediate material is amorphous silicon.
14. The method of claim 1 which further comprises depositing the irregular material layer on the donor substrate.

15. The method of claim 14 which further comprises depositing the irregular layer by chemical vapor deposition (CVD).
16. The method of claim 1 wherein the useful layer of the multilayer semiconductor structure is made of at least one of silicon (Si), silicon-germanium (SiGe), germanium (Ge), silicon-carbon (SiC), gallium-nitride (GaN), gallium-arsenide (GaAs), or a Group (III-V) material.
17. The method of claim 16 wherein the multilayer semiconductor structure is a silicon-on-insulator (SOI) type structure.
18. The method of claim 16 which further comprises providing a layer of electrical insulator material between the useful layer and the layer of irregular material.
19. The method of claim 18 wherein the electrical insulator material is made of silicon-oxide (SiO_2) or Si_3N_4 .
20. The method of claim 19 wherein the electrical insulator layer is about 50 Å thick.
21. The method of claim 1 wherein the layer of irregular material is made of at least one of diamonds, Si_3N_4 , AlN, or poly-crystal silicon.